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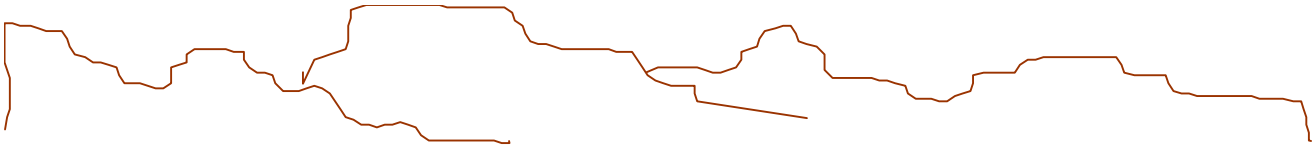


Johnson Controls
Northern New Mexico

P. O. Box 50, MS A199
Los Alamos, NM 87544

Green Zia Analysis of Johnson Controls Northern New Mexico Lacquer Thinner

Background

Johnson Controls Northern New Mexico (JCNNM) is the facility support subcontractor to the Los Alamos National Laboratory (the Laboratory), in Los Alamos, New Mexico. JCNNM operates and maintains the Laboratory's facilities, equipment, property, grounds, infrastructure, and public and private roadways covering over 27,800 acres. All JCNNM work is conducted on behalf of the Laboratory and Department of Energy (DOE).

JCNNM services include steel cleaning and painting in support of various construction and maintenance activities. From October 1997 to September 2000, JCNNM generated approximately 2131kg of spent lacquer thinner per year. As part of its commitment to pollution prevention (P2), the JCNNM Environmental (HENV) and Craft Resources (MDCR) Branches initiated a systematic process to identify, evaluate and implement source reduction opportunities for spent lacquer thinner.

This paper presents the approach used by JCNNM to reduce pollution from spent lacquer thinner. JCNNM's approach utilizes the *New Mexico Green Zia Systems Analysis Tools* (Green Zia tools), as specified in Function Area 3 (Managerial Accomplishments) of Section B, Part II-1, Appendix F of the DOE/University of California contract (2000). The Green Zia tools employed in this project were generally accomplished according to the New Mexico Green Zia Environmental Excellence Award Program guidance at *http://www.nmenv.state.nm.us*. This Green Zia tools report satisfies Goal 4 of Performance Measure 28, "Hazardous Waste Generation," in JCNNM's contract with the Laboratory.

This report discusses the application of the following tools:

- Process mapping of steel cleaning and cleanup operations for spray painting and brush painting;
- Identification and rank ordering of P2 opportunities;
- Root cause analysis;
- Activity-based costing analysis;
- Consensus problem statement;
- Generating P2 alternatives;
- Selecting P2 alternatives; and

– Implementing the selected alternatives with a formal action plan.

JCNNM has an ongoing and formal P2 program committed to reducing waste and environmental releases at the source. The P2 program is documented in a written plan (*JCNNM Pollution Prevention Program Plan For Calendar Years 2001 through 2005*) and P2 practices are incorporated into operating procedures, where appropriate. In addition, JCNNM has P2 performance measures included in its contract with the Laboratory, which influence the subcontract award fee. These documents specify JCNNM's commitment to preventing waste at the source, while also recycling and minimizing waste that cannot be prevented. The performance measures outline P2 requirements, establish numeric goals for reduction of wastes, require tracking and reporting of progress toward meeting the goals, and provide incentives or rewards for waste reduction. Under JCNNM's P2 program, Department Managers (and others who supervise waste generating operations) are challenged and required to incorporate P2 practices to the extent technically and economically feasible.

The Challenge

For DOE Fiscal Years 2000 and 2001 (to date), spent lacquer thinner and related wastes constituted 40 percent of JCNNM's total RCRA hazardous waste generation, excluding fluorescent bulbs. Although most of this waste was recycled by FWO-SWO and did not impact JCNNM's performance measure, it still represented a significant regulatory liability and waste management expense.

The challenge for JCNNM was as follows:
– Identify the operations that generate lacquer thinner;
– Determine the costs and liabilities incurred by using lacquer thinner;
– Identify and evaluate substitution and source reduction alternatives for lacquer thinner use;
– Complete a percent Return on Investment (ROI) analysis for implementing the P2 alternatives over the current process.

Green Zia Lacquer Thinner Team

A multi-disciplinary team was formed to investigate steel cleaning and painting operations. The team included painter foremen and supervisors, as well as those knowledgeable about management and recycling of RCRA hazardous wastes. The following individuals were team members:

– James Merhege, Supervisor, MDCR, JCNNM
– George Lujan, Painter Foreman, MDCR, JCNNM
– L. Vince Rodriguez, RCRA Program Coordinator, HENV, JCNNM/Eberline Services
– Jocelyn Buckley, Training Specialist, ESH-13, LANL
– Jim Stanton, P2 Program Coordinator, HENV, JCNNM/Eberline Services

This team met on several occasions to complete the work on this project.

Process Characterization

The team prepared a process map describing typical steel cleaning, spray painting, and brush painting operations (see Figures 1 to 3). Each step includes labor costs, which are not shown in the figures, but are addressed under Activity-Based Costing, below.

Figure 1. Detailed Process Map Illustrating Steel Cleaning Operations

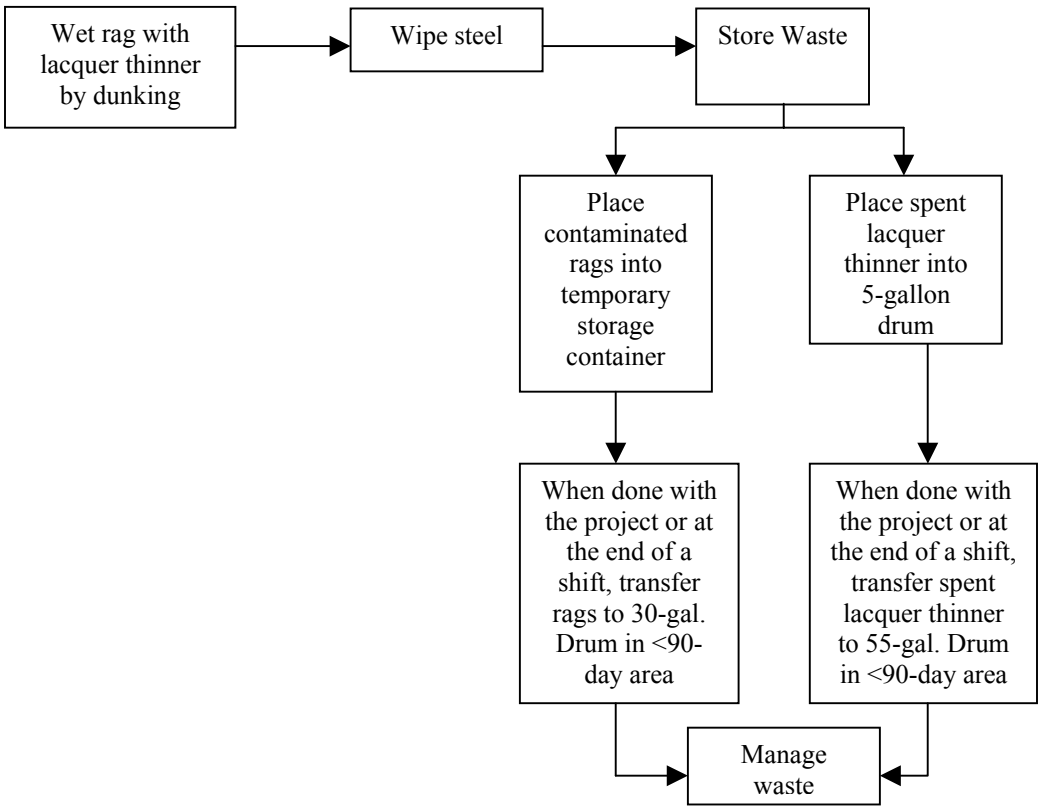


Figure 2. Detailed Process Map Illustrating Spray Painting Operations

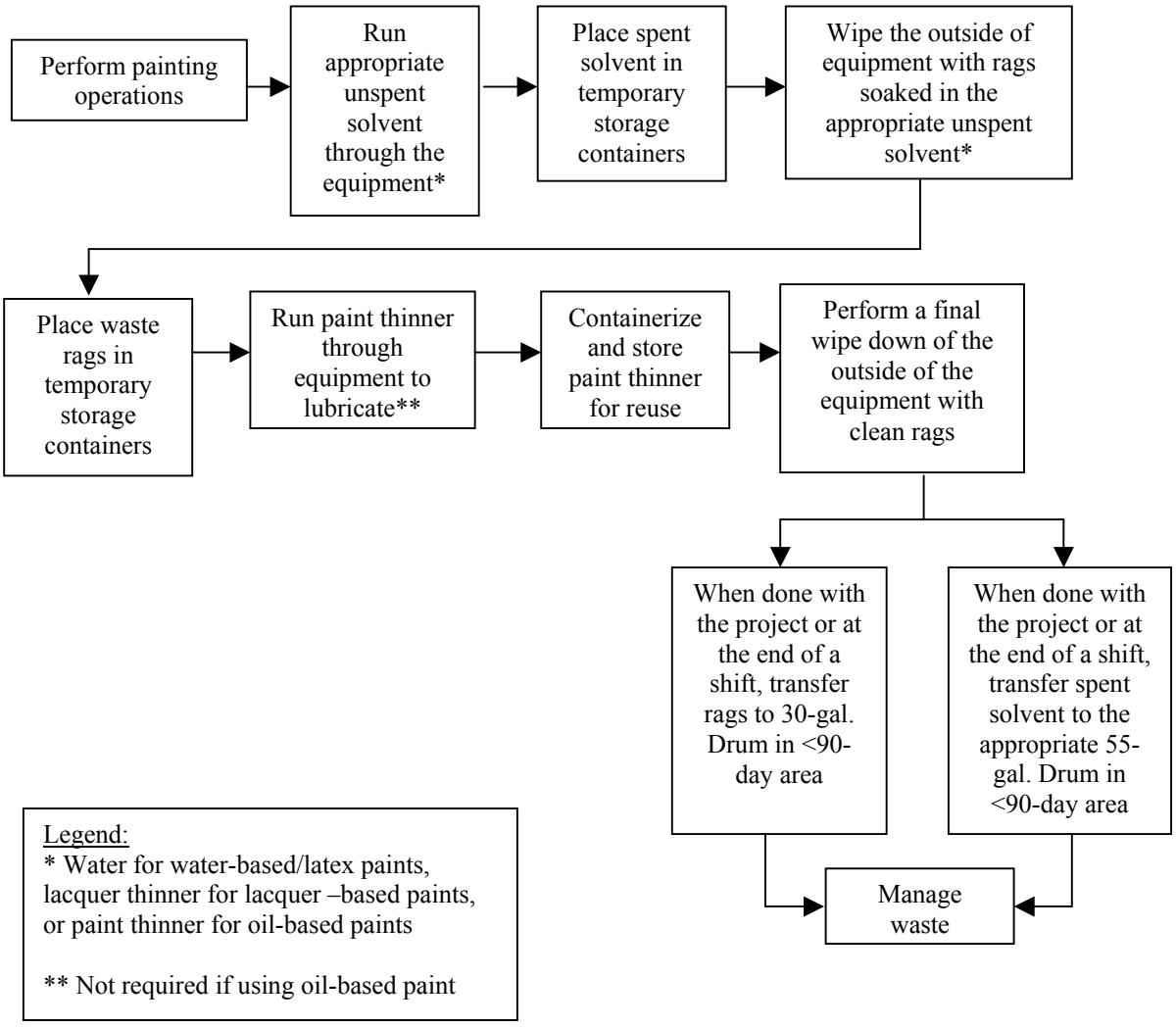
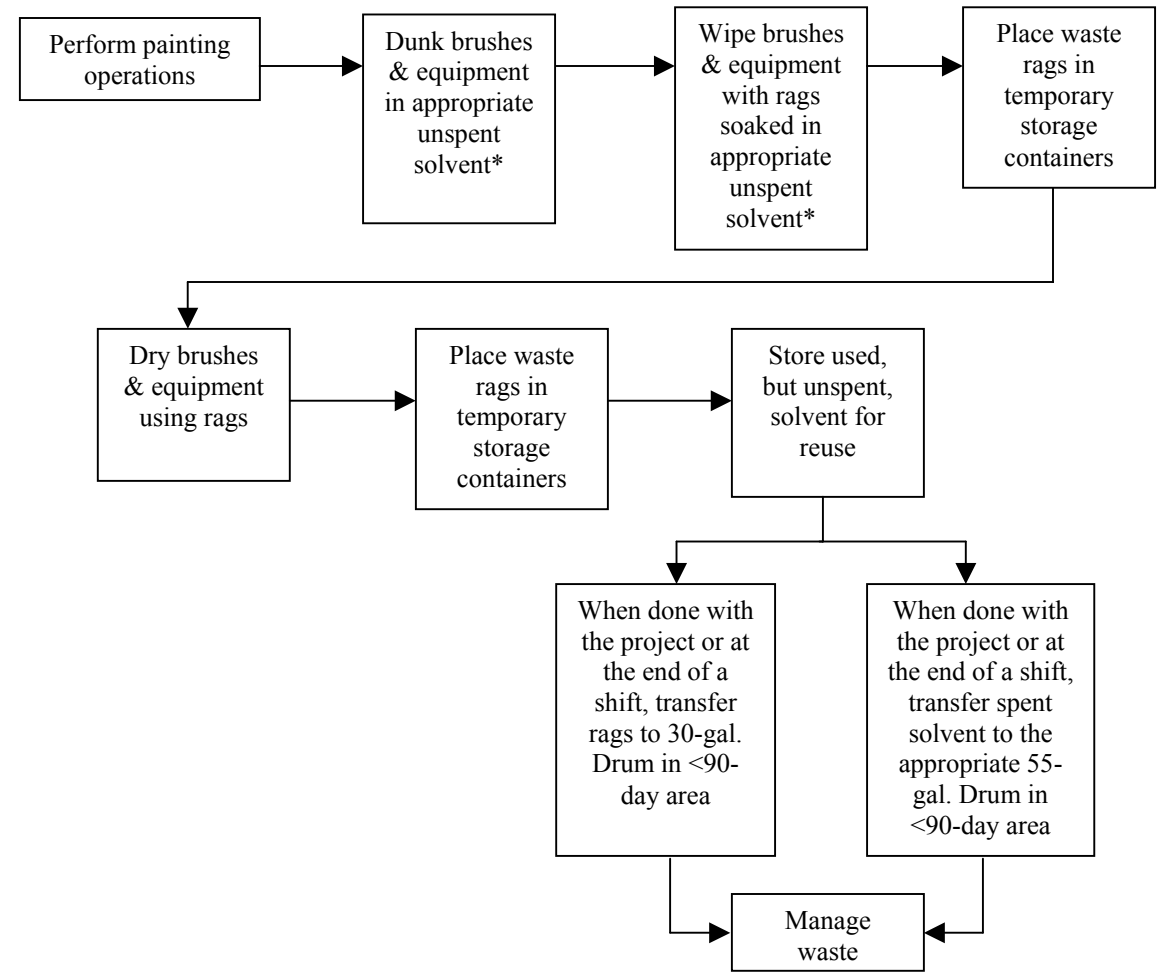


Figure 3. Detailed Process Map Illustrating Brush Painting Cleanup Operations



Statement of Problem

From October 1999 to July 2001, JCNNM generated 6.1 metric tons of RCRA hazardous waste, excluding fluorescent light bulbs generated by the Laboratory but managed by JCNNM. Spent lacquer thinner and the associated contaminated rags currently constitute JCNNM's largest RCRA hazardous waste stream, accounting for 40 percent of JCNNM's total waste generation over that time frame. Additionally, while FWO-SWO has typically recycled spent lacquer thinner (and therefore it has not impacted JCNNM's performance measure), these wastes remain significant liabilities for JCNNM that can be reduced.

Root Cause Analysis

In the course of investigating the spent lacquer thinner waste stream, JCNNM determined that steel cleaning operations generate 85 percent of all spent lacquer thinner and contaminated rags. Painting operations (spray and brush) generate the remaining 15 percent. Therefore, affecting a process change for steel cleaning operations that eliminates the generation of RCRA hazardous waste will greatly reduce JCNNM's waste management liability.

Generating Process Alternatives

In response to the problems stated above, the team used a brainwriting tool to develop P2 alternatives, which are listed below:

1) Substitute lacquer thinner with a non-hazardous product.
2) Recycle lacquer thinner and paint thinner in a solvent still.
3) Segregate paint thinner from lacquer thinner waste to facilitate recycling in the still.
4) Reduce the volume of lacquer thinner used to the absolute minimum.
5) Use only disposable equipment in brush painting operations.
6) Reuse rags whenever possible, including laundering the rags.

Selecting an Alternative

Members of the Green Zia Lacquer Thinner team determined that almost all the P2 alternatives could be readily implemented or were already being performed. JCNNM personnel were already using only the minimum amount of lacquer thinner for the job, were reusing rags to the extent currently possible, and were using disposable brushes where possible.

To determine whether to implement material substitution, solvent still operations, or both, the team performed percent Return on Investment (ROI) calculations based on detailed activity-based costing analyses. Both approaches had ROI percentages greater than 500 percent for each process (Tables 1 to 3; also see Appendix A for more detailed activity-based costing analyses and ROI calculations.). Further, all ROI percentages were greater than 250 percent even when the waste management costs were decreased from $6.00/kg to the $0.75/kg Generator Set Aside Fee assessed by ESO (data not shown). Therefore, both lacquer thinner substitution and installation of the solvent still are cost-effective solutions, with substitution being more cost effective for all three processes (Tables 1 to 3).

After looking at this information, the team chose to implement both options, rather than choosing solvent substitution alone. In making this decision, the team felt that while a substitute could be readily identified and evaluated for steel cleaning operations, installing and operating the solvent still would be valuable for managing spent lacquer and paint thinner from spray and brush painting operations.

Table 1: Summary of Steel Cleaning Analyses

	Estimated Costs			Estimated Savings	
Description	Current Procedure	Material Substitution	Solvent Still	Material Substitution	Solvent Still
Project Funding	$0.00	$984.50	$8,825.20		
Materials	$2,355.30	$990.30	$980.30	$1,365.00	$1,375.00
Waste Management Costs	$21,547.75	$6,822.75	$7,011.50	$14,725.00	$14,536.25
Recycling Costs	$0.00	$0.00	$2,177.50	$0.00	-$2,177.50
Total	**$23,903.05**	**$8,797.55**	**$18,994.50**	**$16,090.00**	**$13,733.75**
ROI (%)				**1,624**	**1,385**

Table 2: Summary of Spray Painting Analyses

	Estimated Costs			Estimated Savings	
Description	Current Procedure	Material Substitution	Solvent Still	Material Substitution	Solvent Still
Project Funding	$0.00	$110.75	$925.90		
Materials	$208.83	$111.33	$208.83	$97.50	$0.00
Waste Management Costs	$2,444.13	$871.63	$1,400.75	$1,572.50	$1,043.38
Recycling Costs	$0.00	$0.00	$217.75	$0.00	-$217.75
Total	**$2,652.96**	**$1,093.71**	**$2,753.23**	**$1,670.00**	**$825.63**
ROI (%)				**1,498**	**735**

Table 3: Summary of Brush Painting Analyses					
	Estimated Costs			Estimated Savings	
Description	Current Procedure	Material Substitution	Solvent Still	Material Substitution	Solvent Still
Project Funding	$0.00	$110.75	$925.90		
Materials	$208.83	$111.33	$208.83	$97.50	$0.00
Waste Management Costs	$2,444.13	$871.63	$1,400.75	$1,572.50	$1,043.38
Recycling Costs	$0.00	$0.00	$217.75	$0.00	-$217.75
Total	**$2,652.96**	**$1,093.71**	**$2,753.23**	**$1,670.00**	**$825.63**
ROI (%)				**1,498**	**735**

Implementing the Alternative

The team prepared an action plan for identifying and evaluating a substitute for lacquer thinner in steel cleaning operations, as well as installing the solvent still for spray and brush painting wastes. Full implementation will be coordinated through the project team, which will meet quarterly to assess progress, identify and implement lessons learned, and quantify the action plan's specified metrics.

The ultimate goal of implementing this action plan would be to reduce JCNNM's generation of spent lacquer thinner waste by 80 percent over FY 2001 levels by the end of FY 2002.

Action Plan
Deadline: 12/31/2001
Responsible Parties: James Merhege, George Lujan

Goal #1: Identify and evaluate potential substitutes for steel cleaning (J. Merhege, G. Lujan)

Objectives:
- Identify cost effective, non-hazardous, green, and SWS friendly solvents that can effectively clean steel;
- Perform a pilot project on selected substitutes; and
- Begin using the substitute and characterize the spent material.

Goal #2: Segregate paint thinner waste from lacquer thinner waste during all operations, especially cleanup after spray and brush painting. (J. Merhege, G. Lujan)

Goal #3: Install and operate the solvent still for segregated thinner wastes from spray and brush painting operations. (J. Merhege, G. Lujan)

Objectives:

- Identify most appropriate location for unit operations;
- Secure funding for installation labor;
- Identify and resolve regulatory requirements associated with unit location and operations;
- Develop operating procedures and safety documentation;
- Coordinate with appropriate JCNNM and Laboratory personnel to complete installation.
- Develop and give training;
- Perform management readiness review;
- Develop pre-operational checklist;
- Establish points of contact for unit use, inspections, etc.; and
- Coordinate industrial hygiene air sampling to verify unit performance.

APPENDIX A:
DETAILED ACTVITY-BASED COSTING TABLES

Activity-Based Costing Table 1: Steel Cleaning

Existing:
Steel is cleaned with lacquer thinner and rags.

Proposed:
Eliminate hazardous spent lacquer thinner by material substitution or recovery/reuse (solvent still).

Current Estimated Costs

Activity	Org.	Number	Rate	Hrs/Drum	Drums/Yr	Total
Transfer waste to <90 day area	JCNNM	1	$33.50	0.5	5	$83.75
Collect MSDSs	HENV	1	$60.00	0.1	5	$30.00
Prepare waste documentation	HENV	1	$60.00	0.5	5	$150.00
Inspect waste storage areas	HENV	1	$60.00	1	5	$300.00
Package the waste (bulk thinner)	JCNNM	1	$33.50	2.5	5	$418.75
Package the waste (rags)	JCNNM	1	$33.50	0.5	3	$50.25
Oversee transport to TA-54	JCNNM	1	$60.00	0.75	5	$225.00

Materials & Fees	Org.	Unit	Rate	Units/Drum	Drums/Yr	Total
Virgin Lacquer Thinner	JCNNM	gallon	$5.00	55	7	$1,925.00
Virgin rags	JCNNM	Package	$28.30	5	3	$424.50
PPE (Gloves)	JCNNM	Package	$1.16	1	5	$5.80
Waste Disposal Fee (bulk lacquer)	DOE-DP	kg	$6.00	275	5	$8,250.00
Waste Disposal Fee (rags & gloves)	DOE-DP	kg	$6.00	150	3	$2,700.00
NMED Fines	FWO	EA	$25,000.00	0.02	9	$4,500.00
Lost Subcontractor Fee	JCNNM	EA	$25,000.00	0.02	9	$4,500.00
Waste Container Costs (55-gallon drums)	JCNNM	EA	$50.00	1	5	$250.00
Waste Container Costs (30-gallon drums)	JCNNM	EA	$30.00	1	3	$90.00

Total estimated cost per year	$23,903.05

Material Substitution

Activity	Org.	Number	Rate	Hrs/Drum	Drums/Yr	Total
Transfer waste to <90 day area	JCNNM	1	$33.50	0.5	5	$83.75
Collect MSDSs	HENV	1	$60.00	0.1	5	$30.00
Prepare waste documentation	HENV	1	$60.00	0.5	5	$150.00
Inspect waste storage areas	HENV	1	$60.00	0.25	5	$75.00
Package the waste (bulk thinner)	JCNNM	1	$33.50	2.5	5	$418.75
Package the waste (rags)	JCNNM	1	$33.50	0.5	3	$50.25
Oversee transport to TA-54	JCNNM	1	$60.00	0.75	5	$225.00

Materials & Fees	Org.	Unit	Rate	Units/Drum	Drums/Yr	Total
Virgin Steel Cleaner	JCNNM	gallon	$400.00	0.2	7	$560.00
Virgin rags	JCNNM	Package	$28.30	5	3	$424.50

PPE (Gloves)	JCNNM	Package	$1.16	1	5	$5.80
Waste Disposal Fee (bulk cleaner)	DOE-DP	kg	$2.00	275	5	$2,750.00
Waste Disposal Fee (rags & gloves)	DOE-DP	kg	$6.00	150	3	$2,700.00
NMED Fines	FWO	EA	$25,000.00	0	9	$0.00
Lost Subcontractor Fee	JCNNM	EA	$25,000.00	0	9	$0.00
Waste Container Costs (55-gallon drums)	JCNNM	EA	$50.00	1	5	$250.00
Waste Container Costs (30-gallon drums)	JCNNM	EA	$30.00	1	3	$90.00
Total estimated cost per year						$7,813.05

Solvent Still

Activity	Org.	Number	Rate	Hrs/Drum	Drums/Yr	Total
Transfer waste to <90 day area	JCNNM	1	$33.50	0.5	0	$0.00
Collect MSDSs	HENV	1	$60.00	0.1	5	$30.00
Prepare waste documentation	HENV	1	$60.00	0.5	5	$150.00
Inspect waste storage areas	HENV	1	$60.00	0.25	5	$75.00
Package the waste (bulk thinner)	JCNNM	1	$33.50	2.5	5	$418.75
Package the waste (rags)	JCNNM	1	$33.50	0.5	3	$50.25
Operate the still	JCNNM	1	$33.50	12.5	5	$2,093.75
Oversee transport to TA-54	JCNNM	1	$60.00	0.75	3	$135.00
Transfer waste to solvent still	JCNNM	1	$33.50	0.5	5	$83.75

Materials & Fees	Org.	Unit	Rate	Units/Drum	Drums/Yr	Total
Virgin Lacquer Thinner	JCNNM	Gallon	$5.00	55	2	$550.00
Virgin rags	JCNNM	Package	$28.30	5	3	$424.50
PPE (Gloves)	JCNNM	Package	$1.16	1	5	$5.80
Waste Disposal Fee (bulk lacquer)	DOE-DP	kg	$6.00	275	0	$0.00
Waste Disposal Fee (rags & gloves)	DOE-DP	kg	$6.00	150	3	$2,700.00
NMED Fines	FWO	EA	$25,000.00	0	9	$0.00
Lost Subcontractor Fee	JCNNM	EA	$25,000.00	0	9	$0.00
Waste Container Costs (55-gallon drums)	JCNNM	EA	$50.00	1	1	$50.00
Waste Container Costs (30-gallon drums)	JCNNM	EA	$30.00	1	3	$90.00
Waste Disposal Fee (sludge)	DOE-DP	Kg	$6.00	275	1.25	$2,062.50
Sample/analyze collected wastes	Assagai	1	$1,000.00	1	1.25	$1,250.00
Total estimated cost per year						$8,919.30

Activity-Based Costing Table 2: Spray Painting Cleanup

Existing:

Spray paint equipment is cleaned with lacquer thinner and rags.

Proposed:

Eliminate hazardous spent lacquer thinner by material substitution or recovery/reuse (solvent still).

Current Estimated Costs

Activity	Org.	Number	Rate	Hrs/Drum	Drums/Yr	Total
Transfer waste to <90 day area	JCNNM	1	$33.50	0.5	0.5	$8.38
Collect MSDSs	HENV	1	$60.00	0.1	0.5	$3.00
Prepare waste documentation	HENV	1	$60.00	0.5	0.5	$15.00
Inspect waste storage areas	HENV	1	$60.00	1	0.5	$30.00
Package the waste (bulk thinner)	JCNNM	1	$33.50	2.5	0.5	$41.88
Package the waste (rags)	JCNNM	1	$33.50	0.5	0.5	$8.38
Oversee transport to TA-54	JCNNM	1	$60.00	0.75	0.5	$22.50

Materials & Fees	Org.	Unit	Rate	Units/Drum	Drums/Yr	Total
Virgin Lacquer Thinner	JCNNM	Gallon	$5.00	55	0.5	$137.50
Virgin rags	JCNNM	Package	$28.30	5	0.5	$70.75
PPE (Gloves)	JCNNM	Package	$1.16	1	0.5	$0.58
Waste Disposal Fee (bulk lacquer)	DOE-DP	Kg	$6.00	275	0.5	$825.00
Waste Disposal Fee (rags & gloves)	DOE-DP	Kg	$6.00	150	0.5	$450.00
NMED Fines	FWO	EA	$25,000.00	0.02	1	$500.00
Lost Subcontractor Fee	JCNNM	EA	$25,000.00	0.02	1	$500.00
Waste Container Costs (55-gallon drums)	JCNNM	EA	$50.00	1	0.5	$25.00
Waste Container Costs (30-gallon drums)	JCNNM	EA	$30.00	1	0.5	$15.00
Total estimated cost						$2,652.96

Material Substitution

Activity	Org.	Number	Rate	Hrs/Drum	Drums/Yr	Total
Transfer waste to <90 day area	JCNNM	1	$33.50	0.5	0.5	$8.38
Collect MSDSs	HENV	1	$60.00	0.1	0.5	$3.00
Prepare waste documentation	HENV	1	$60.00	0.5	0.5	$15.00
Inspect waste storage areas	HENV	1	$60.00	0.25	0.5	$7.50
Package the waste (bulk thinner)	JCNNM	1	$33.50	2.5	0.5	$41.88
Package the waste (rags)	JCNNM	1	$33.50	0.5	0.5	$8.38
Oversee transport to TA-54	JCNNM	1	$60.00	0.75	0.5	$22.50

Materials & Fees	Org.	Unit	Rate	Units/Drum	Drums/Yr	Total
Virgin Lacquer Thinner	JCNNM	Gallon	$400.00	0.2	0.5	$40.00
Virgin rags	JCNNM	Package	$28.30	5	0.5	$70.75
PPE (Gloves)	JCNNM	Package	$1.16	1	0.5	$0.58
Waste Disposal Fee (bulk cleaner)	DOE-DP	Kg	$2.00	275	0.5	$275.00
Waste Disposal Fee (rags & gloves)	DOE-DP	Kg	$6.00	150	0.5	$450.00
NMED Fines	FWO	EA	$25,000.00	0	1	$0.00
Lost Subcontractor Fee	JCNNM	EA	$25,000.00	0	1	$0.00
Waste Container Costs (55-gallon drums)	JCNNM	EA	$50.00	1	0.5	$25.00
Waste Container Costs (30-gallon drums)	JCNNM	EA	$30.00	1	0.5	$15.00
Total estimated cost						$982.96

Solvent Still

Activity	Org.	Number	Rate	Hrs/Drum	Drums/Yr	Total
Transfer waste to <90 day area	JCNNM	1	$33.50	0.5	0	$0.00
Collect MSDSs	HENV	1	$60.00	0.1	0.5	$3.00
Prepare waste documentation	HENV	1	$60.00	0.5	0.5	$15.00
Inspect waste storage areas	HENV	1	$60.00	0.25	0.5	$7.50
Package the waste (bulk thinner)	JCNNM	1	$33.50	2.5	0.5	$41.88
Package the waste (rags)	JCNNM	1	$33.50	0.5	0.5	$8.38
Operate the still	JCNNM	1	$33.50	12.5	0.5	$209.38
Transfer waste to solvent still	JCNNM	1	$33.50	0.5	0.5	$8.38
Oversee transport to TA-54	JCNNM	1	$60.00	0.75	0.5	$22.50

Materials & Fees	Org.	Unit	Rate	Units/Drum	Drums/Yr	Total
Virgin Lacquer Thinner	JCNNM	Gallon	$5.00	55	0.5	$137.50
Virgin rags	JCNNM	Package	$28.30	5	0.5	$70.75
PPE (Gloves)	JCNNM	Package	$1.16	1	0.5	$0.58
Waste Disposal Fee (bulk lacquer)	DOE-DP	Kg	$6.00	275	0	$0.00
Waste Disposal Fee (rags & gloves)	DOE-DP	Kg	$6.00	150	0.5	$450.00
NMED Fines	FWO	EA	$25,000.00	0	1	$0.00
Lost Subcontractor Fee	JCNNM	EA	$25,000.00	0	1	$0.00
Waste Container Costs (55-gallon drums)	JCNNM	EA	$50.00	1	0.5	$25.00
Waste Container Costs (30-gallon drums)	JCNNM	EA	$30.00	1	0.5	$15.00
Waste Disposal Fee (sludge)	DOE-DP	kg	$6.00	275	0.25	$412.50
Sample/analyze collected wastes	Assagai	1	$1,000.00	1	0.4	$400.00
Total estimated cost						$1,427.33

Activity-Based Costing Table 3: Brush Painting Cleanup

Existing:

Brushes and similar painting equipment is cleaned with lacquer thinner and rags.

Proposed:

Eliminate hazardous spent lacquer thinner by material substitution or recovery/reuse (solvent still).

Current Estimated Costs

Activity	Org.	Number	Rate	Hrs/Drum	Drums/Yr	Total
Transfer waste to <90 day area	JCNNM	1	$33.50	0.5	0.5	$8.38
Collect MSDSs	HENV	1	$60.00	0.1	0.5	$3.00
Prepare waste documentation	HENV	1	$60.00	0.5	0.5	$15.00
Inspect waste storage areas	HENV	1	$60.00	1	0.5	$30.00
Package the waste (bulk thinner)	JCNNM	1	$33.50	2.5	0.5	$41.88
Package the waste (rags)	JCNNM	1	$33.50	0.5	0.5	$8.38
Oversee transport to TA-54	JCNNM	1	$60.00	0.75	0.5	$22.50

Materials & Fees	Org.	Unit	Rate	Units/Drum	Drums/Yr	Total
Virgin Lacquer Thinner	JCNNM	Gallon	$5.00	55	0.5	$137.50
Virgin rags	JCNNM	Package	$28.30	5	0.5	$70.75
PPE (Gloves)	JCNNM	Package	$1.16	1	0.5	$0.58
Waste Disposal Fee (bulk lacquer)	DOE-DP	Kg	$6.00	275	0.5	$825.00
Waste Disposal Fee (rags & gloves)	DOE-DP	Kg	$6.00	150	0.5	$450.00
NMED Fines	FWO	EA	$25,000.00	0.02	1	$500.00
Lost Subcontractor Fee	JCNNM	EA	$25,000.00	0.02	1	$500.00
Waste Container Costs (55-gallon drums)	JCNNM	EA	$50.00	1	0.5	$25.00
Waste Container Costs (30-gallon drums)	JCNNM	EA	$30.00	1	0.5	$15.00
Total estimated cost						$2,652.96

Material Substitution

Activity	Org.	Number	Rate	Hrs/Drum	Drums/Yr	Total
Transfer waste to <90 day area	JCNNM	1	$33.50	0.5	0.5	$8.38
Collect MSDSs	HENV	1	$60.00	0.1	0.5	$3.00
Prepare waste documentation	HENV	1	$60.00	0.5	0.5	$15.00
Inspect waste storage areas	HENV	1	$60.00	0.25	0.5	$7.50
Package the waste (bulk thinner)	JCNNM	1	$33.50	2.5	0.5	$41.88
Package the waste (rags)	JCNNM	1	$33.50	0.5	0.5	$8.38
Oversee transport to TA-54	JCNNM	1	$60.00	0.75	0.5	$22.50

Materials & Fees	Org.	Unit	Rate	Units/Drum	Drums/Yr	Total
Virgin Lacquer Thinner	JCNNM	Gallon	$400.00	0.2	0.5	$40.00
Virgin rags	JCNNM	Package	$28.30	5	0.5	$70.75
PPE (Gloves)	JCNNM	Package	$1.16	1	0.5	$0.58
Waste Disposal Fee (bulk cleaner)	DOE-DP	Kg	$2.00	275	0.5	$275.00
Waste Disposal Fee (rags & gloves)	DOE-DP	Kg	$6.00	150	0.5	$450.00
NMED Fines	FWO	EA	$25,000.00	0	1	$0.00
Lost Subcontractor Fee	JCNNM	EA	$25,000.00	0	1	$0.00
Waste Container Costs (55-gallon drums)	JCNNM	EA	$50.00	1	0.5	$25.00
Waste Container Costs (30-gallon drums)	JCNNM	EA	$30.00	1	0.5	$15.00
Total estimated cost						$982.96

Solvent Still

Activity	Org.	Number	Rate	Hrs/Drum	Drums/Yr	Total
Transfer waste to <90 day area	JCNNM	1	$33.50	0.5	0	$0.00
Collect MSDSs	HENV	1	$60.00	0.1	0.5	$3.00
Prepare waste documentation	HENV	1	$60.00	0.5	0.5	$15.00
Inspect waste storage areas	HENV	1	$60.00	0.25	0.5	$7.50
Package the waste (bulk thinner)	JCNNM	1	$33.50	2.5	0.5	$41.88
Package the waste (rags)	JCNNM	1	$33.50	0.5	0.5	$8.38
Operate the still	JCNNM	1	$33.50	12.5	0.5	$209.38
Transfer waste to solvent still	JCNNM	1	$33.50	0.5	0.5	$8.38
Oversee transport to TA-54	JCNNM	1	$60.00	0.75	0.5	$22.50

Materials & Fees	Org.	Unit	Rate	Units/Drum	Drums/Yr	Total
Virgin Lacquer Thinner	JCNNM	Gallon	$5.00	55	0.5	$137.50
Virgin rags	JCNNM	Package	$28.30	5	0.5	$70.75
PPE (Gloves)	JCNNM	Package	$1.16	1	0.5	$0.58
Waste Disposal Fee (bulk lacquer)	DOE-DP	Kg	$6.00	275	0	$0.00
Waste Disposal Fee (rags & gloves)	DOE-DP	Kg	$6.00	150	0.5	$450.00
NMED Fines	FWO	EA	$25,000.00	0	1	$0.00
Lost Subcontractor Fee	JCNNM	EA	$25,000.00	0	1	$0.00
Waste Container Costs (55-gallon drums)	JCNNM	EA	$50.00	1	0.5	$25.00
Waste Container Costs (30-gallon drums)	JCNNM	EA	$30.00	1	0.5	$15.00
Waste Disposal Fee (sludge)	DOE-DP	kg	$6.00	275	0.25	$412.50
Sample/analyze collected wastes	Assagai	1	$1,000.00	1	0.4	$400.00
Total estimated cost						$1,427.33

Activity-Based Costing Table 4: Steel Cleaning ROI Calculation

Itemized Project Non-Equipment Costs FY01	*Current Procedure*	*Material Substitution*	*Solvent Still*
Resource			
Planning/Procedure Writing	$0.00	$0.00	$2,460.00
Training	$0.00	$984.50	$956.00
Misc. Supplies	$0.00	$0.00	$0.00
Startup/testing	$0.00	$0.00	$630.00
Travel	$0.00	$0.00	$0.00
Readiness reviews/management assessments/admin costs	$0.00	$0.00	$187.50
Other operating expenses	$0.00	$0.00	$0.00
Total: Projected Non-Equipment Cost = (E)	**$0.00**	**$984.50**	**$4,233.50**

Itemized Project Equipment Funding Requirements	*Current Procedure*	*Material Substitution*	*Solvent Still*
Resource			
Design	$0.00	$0.00	$0.00
Purchase (Chiller)	$0.00	$0.00	$4,250.00
Installation	$0.00	$0.00	$341.70
Other equipment investments	$0.00	$0.00	$0.00
Total: Equipment Cost = (C)	**$0.00**	**$0.00**	**$4,591.70**
Total Project Funding Requirements = (C+E)	**$0.00**	**$984.50**	**$8,825.20**

ROI Calculation	*Current Procedure*	*Material Substitution*	*Solvent Still*
Resource			
Equipment	$0.00	$0.00	$0.00
Purchased raw materials & supplies	$2,349.50	$984.50	$974.50

Process operation costs	$0.00	$0.00	$0.00
PPE & related health/safety supply costs	$5.80	$5.80	$5.80
Waste management costs			
Transfer waste to <90 day area	$83.75	$83.75	$0.00
Collect MSDSs	$30.00	$30.00	$30.00
Prepare waste documentation	$150.00	$150.00	$150.00
Inspect waste storage areas	$300.00	$75.00	$75.00
Package the waste (bulk thinner)	$418.75	$418.75	$418.75
Package the waste (rags)	$50.25	$50.25	$50.25
Oversee transport to TA-54	$225.00	$225.00	$135.00
Waste Container Costs (55-gallon drums)	$250.00	$250.00	$50.00
Waste Container Costs (30-gallon drums)	$90.00	$90.00	$90.00
Waste Disposal Fee (sludge)	$0.00	$0.00	$2,062.50
Sample/analyze collected wastes	$0.00	$0.00	$1,250.00
Waste Disposal Fee (bulk lacquer)	$8,250.00	$2,750.00	$0.00
Waste Disposal Fee (rags & gloves)	$2,700.00	$2,700.00	$2,700.00
NMED Fines	$4,500.00	$0.00	$0.00
Lost Subcontractor Fee	$4,500.00	$0.00	$0.00
Recycling costs			
Operate the still	$0.00	$0.00	$2,093.75
Transfer waste to solvent still	$0.00	$0.00	$83.75
Total	**$23,903.05**	**$7,813.05**	**$10,169.30**
Useful Project Life in years (L):	**10**	**10**	**10**
Time to Implement (years):	**0**	**1**	**1**
Estimated Project Termination or Disassembly Cost	**$0.00**	**$0.00**	**$0.00**
ROI %		**1624.3**	**1385.0**

Activity-Based Costing Table 5: Spray Painting ROI Calculation

Itemized Project Non-Equipment Costs FY01	*Current Procedure*	*Material Substitution*	*Solvent Still*
Resource			
Planning/Procedure Writing	$0.00	$0.00	$120.00
Training	$0.00	$110.75	$97.00
Misc. Supplies	$0.00	$0.00	$0.00
Startup/testing	$0.00	$0.00	$45.00
Travel	$0.00	$0.00	$0.00
Readiness reviews/management assessments/admin costs	$0.00	$0.00	$258.75
Other operating expenses	$0.00	$0.00	$0.00
Total: Projected Non-Equipment Cost = (E)	**$0.00**	**$110.75**	**$520.75**

Itemized Project Equipment Funding Requirements	*Current Procedure*	*Material Substitution*	*Solvent Still*
Resource			
Design	$0.00	$0.00	$0.00
Purchase (Chiller)	$0.00	$0.00	$375.00
Installation	$0.00	$0.00	$30.15
Other equipment investments	$0.00	$0.00	$0.00
Total: Equipment Cost = (C)	**$0.00**	**$0.00**	**$405.15**
Total Project Funding Requirements = (C+E)	**$0.00**	**$110.75**	**$925.90**

ROI Calculation	*Current Procedure*	*Material Substitution*	*Solvent Still*
Resource			
Equipment	$0.00	$0.00	$0.00
Purchased raw materials & supplies	$208.25	$110.75	$208.25
Process operation costs	$0.00	$0.00	$0.00
PPE & related health/safety supply costs	$0.58	$0.58	$0.58

Waste management costs			
Transfer waste to <90 day area	$8.38	$8.38	$0.00
Collect MSDSs	$3.00	$3.00	$3.00
Prepare waste documentation	$15.00	$15.00	$15.00
Inspect waste storage areas	$30.00	$7.50	$7.50
Package the waste (bulk thinner)	$41.88	$41.88	$41.88
Package the waste (rags)	$8.38	$8.38	$8.38
Oversee transport to TA-54	$22.50	$22.50	$22.50
Waste Container Costs (55-gallon drums)	$25.00	$25.00	$25.00
Waste Container Costs (30-gallon drums)	$15.00	$15.00	$15.00
Waste Disposal Fee (sludge)	$0.00	$0.00	$412.50
Sample/analyze collected wastes	$0.00	$0.00	$400.00
Waste Disposal Fee (bulk lacquer)	$825.00	$275.00	$0.00
Waste Disposal Fee (rags & gloves)	$450.00	$450.00	$450.00
NMED Fines	$500.00	$0.00	$0.00
Lost Subcontractor Fee	$500.00	$0.00	$0.00
Recycling costs			
Operate the still	$0.00	$0.00	$209.38
Transfer waste to solvent still	$0.00	$0.00	$8.38
Total	**$2,652.96**	**$982.96**	**$1,827.33**
Useful Project Life in years (L):	**10**	**10**	**10**
Time to Implement (years):	**0**	**1**	**1**
Estimated Project Termination or Disassembly Cost	**$0.00**	**$0.00**	**$0.00**
ROI %		**1497.9**	**735.5**

Activity-Based Costing Table 6: Brush Painting Cleanup ROI Calculation

Itemized Project Non-Equipment Costs FY01	*Current Procedure*	*Material Substitution*	*Solvent Still*
Resource			
Planning/Procedure Writing	$0.00	$0.00	$120.00
Training	$0.00	$110.75	$97.00
Misc. Supplies	$0.00	$0.00	$0.00
Startup/testing	$0.00	$0.00	$45.00
Travel	$0.00	$0.00	$0.00
Readiness reviews/management assessments/admin costs	$0.00	$0.00	$258.75
Other operating expenses	$0.00	$0.00	$0.00
Total: Projected Non-Equipment Cost = (E)	**$0.00**	**$110.75**	**$520.75**

Itemized Project Equipment Funding Requirements	*Current Procedure*	*Material Substitution*	*Solvent Still*
Resource			
Design	$0.00	$0.00	$0.00
Purchase (Chiller)	$0.00	$0.00	$375.00
Installation	$0.00	$0.00	$30.15
Other equipment investments	$0.00	$0.00	$0.00
Total: Equipment Cost = (C)	**$0.00**	**$0.00**	**$405.15**
Total Project Funding Requirements = (C+E)	**$0.00**	**$110.75**	**$925.90**

ROI Calculation	*Current Procedure*	*Material Substitution*	*Solvent Still*
Resource			
Equipment	$0.00	$0.00	$0.00
Purchased raw materials & supplies	$208.25	$110.75	$208.25
Process operation costs	$0.00	$0.00	$0.00
PPE & related health/safety supply costs	$0.58	$0.58	$0.58

Waste management costs			
Transfer waste to <90 day area	$8.38	$8.38	$0.00
Collect MSDSs	$3.00	$3.00	$3.00
Prepare waste documentation	$15.00	$15.00	$15.00
Inspect waste storage areas	$30.00	$7.50	$7.50
Package the waste (bulk thinner)	$41.88	$41.88	$41.88
Package the waste (rags)	$8.38	$8.38	$8.38
Oversee transport to TA-54	$22.50	$22.50	$22.50
Waste Container Costs (55-gallon drums)	$25.00	$25.00	$25.00
Waste Container Costs (30-gallon drums)	$15.00	$15.00	$15.00
Waste Disposal Fee (sludge)	$0.00	$0.00	$412.50
Sample/analyze collected wastes	$0.00	$0.00	$400.00
Waste Disposal Fee (bulk lacquer)	$825.00	$275.00	$0.00
Waste Disposal Fee (rags & gloves)	$450.00	$450.00	$450.00
NMED Fines	$500.00	$0.00	$0.00
Lost Subcontractor Fee	$500.00	$0.00	$0.00
Recycling costs			
Operate the still	$0.00	$0.00	$209.38
Transfer waste to solvent still	$0.00	$0.00	$8.38
Total	**$2,652.96**	**$982.96**	**$1,827.33**
Useful Project Life in years (L):	**10**	**10**	**10**
Time to Implement (years):	**0**	**1**	**1**
Estimated Project Termination or Disassembly Cost	**$0.00**	**$0.00**	**$0.00**
ROI %		**1497.9**	**735.5**